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THE BATTLE OF BRITAIN, A STUDY IN COMMAND AND CONTROL  
AN INDIVIDUAL STUDY PROJECT

by

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## ABSTRACT

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The Battle of Britain is thought to be the greatest air battle in history. This battle began on 10 July 1940 and ended on 31 October 1940. It followed the German Blitzkrieg of the Low Countries and France and the ignoble British retreat through Dunkirk. During the previous months the German Luftwaffe had triumphed over the air forces of Poland, Norway, Holland, Belgium and France and had destroyed all but 66 of the 260 British Hurricanes sent to support the British Army in France. The German victories gave rise to beliefs of invincibility which were replaced by feelings of frustration and failure as the Battle of Britain progressed. Arguably the lack of a coherent plan for the German invasion of Britain, Operation Sealion, and the heroics of the British pilots and ground crews influenced the outcome of the Battle of Britain. However, it is the contention of this study that the Command and Control systems of the British coupled with the technology that made those systems possible were responsible for the British victory. The individual systems, RADAR, radio, Identification Friend or Foe (IFF), direction finding and intelligence, and how they were integrated into the command and control structure are discussed.

## Introduction

Fifty years ago Prime Minister Winston Churchill envisioned the beginning of the Battle of Britain with these words,

"What General Weygand called the Battle of France is over. I expect that the Battle of Britain is about to begin. The whole fury and might of the enemy must very soon be turned on us. Hitler knows that he will have to defeat us in this Island or lose the war. If we can stand up to him, all Europe may be free...."<sup>1</sup>

Thus begins what has been described as the greatest air battle in history. The battle officially began on 10 July 1940 and ended, just 114 days later, on the thirty-first of October. To understand the importance of this campaign you must first understand the battles that preceded it. Britain's astonishing victory immediately followed Germany's crushing defeats of Norway, the Low Countries and France.

Considering the dismal defeat of the French Forces, the piecemeal destruction of the British Air Forces in Norway and France, and the ignoble retreat of the British at Dunkirk; what can possibly explain Britain's resounding victory during the Battle of Britain? Much has been written about the lack of a coherent German plan and the heroism of the British pilots; however, these things alone cannot justify the results. The only plausible explanation for Britain's triumph is Command and Control.

## The Invasion of Scandinavia

The German invasion of Norway and Denmark began in the early hours of 9 April 1940. Denmark fell twelve hours later, its 15,000 man Army powerless against the numerically superior German forces.<sup>2</sup>

The Norwegian Armed Forces were aided by British and French expeditionary forces. The British expeditionary forces initially consisted of three plus brigades supported by one Gladiator Squadron, the 263rd. The 263rd Squadron sailed for Norway on 21 April 1940 aboard the aircraft carrier HMS Glorious. On 24 April the 263rd Squadron left the HMS Glorious and flew the last miles to land on a frozen lake. During the next twenty-four hours, thirteen of the eighteen Gladiators were destroyed by the German Luftwaffe strafing and dive-bombing the lake. The 26th of April saw the destruction of two more of the Gladiators and the remaining three were destroyed on 27 April. During the three days that the 263rd had seen battle, they had flown only forty-nine sorties, had claimed fourteen victories against enemy aircraft, only six which were ever confirmed and had lost all eighteen of their aircraft. On 28 April the squadron personnel left Norway on a cargo vessel, arriving in England on 1 May.

The 20th of May saw the reformed and re-equipped 263rd Squadron again flying off an aircraft carrier to rejoin the Norwegian battle. The 263rd was joined on 26 May by the Hurricane equipped 46th Squadron. For the next twelve days these two squadrons were to be in combat ninety-five times and claim thirty-seven enemy aircraft kills along with eight probable kills. On 7 June, the battle for Norway lost, having lost 50% of their aircraft, the two squadrons landed their remaining eighteen aircraft on the HMS Glorious for return to England. The tragedy continued with the sinking of the HMS Glorious on 8 June

and the loss of all remaining eighteen airplanes and all but two of the pilots who had flown in Norway. The forty-five days of this debacle had seen the loss of three squadrons of aircraft and, more importantly, the loss of almost two full squadrons of pilots.<sup>3</sup>

### **The Blitzkrieg**

Even before the conclusion of the Battle in Norway, German combined arms operations had begun in Holland and Belgium. These operations were the first moves in Germany's planned attack on France. Combining armor and infantry with the use of airborne and air-landed infantry and supporting these forces with over 4000 aircraft of all types the German forces were unstoppable. The Dutch, Belgium, French and British Expeditionary Force combined had 149 divisions compared to the Germans 136. Even with the superior number of ground forces, the allies could not match the superb German tactics. The unity of command and coherent communications systems allowed the German forces to carry out their Blitzkrieg tactics while the allies floundered with disjointed command and control systems.<sup>4</sup>

The German invasion started on 10 May 1940 and ended with the French surrender on 22 June. During the first ten days of these battles the British Fighter Command continued to feed fighter squadrons to the German Luftwaffe. On 13 May in response to pleas from the King of the Belgians, the Queen of the Netherlands, the French and the British Expeditionary Forces the British War Cabinet sent 31 additional Hurricanes to re-enforce

the 10 previously deployed Squadrons. On 14 May, the cry for additional fighter support reached a crescendo with the French Premier requesting ten additional squadrons for immediate deployment. His pleas for assistance were joined by those of the British pilots. These pilots, sensing that they were inflicting far greater damage to the Luftwaffe than they were sustaining, longed for additional help. Paul Richey, a pilot with I Squadron, perhaps best summed up the feelings when he wrote:

'...we hadn't wanted this bloody awful war...we had been forced to fight. "And now that we are fighting we'll teach you rotten Huns how to fight. We'll make you wish to Christ you'd never heard of the airplane! We'll teach you the facts of war!" And we knew we could - if we were reinforced....We knew the Huns couldn't keep going at that rate, but we also knew we couldn't keep it up much longer without help.'

Air Marshall Sir Hugh Caswall Tremenheere Dowding CB, CMG, the head of the Fighter Command, who was tasked with providing for the security of Britain, was very concerned with the flow of fighter squadrons to France. He felt that to perform his mission of defending Britain that he would require 53 fighter squadrons. Air Marshall Dowding appeared before a Chiefs of Staff meeting with Winston Churchill on the 15th of May. During this meeting Dowding produced figures which showed that if his present force was further depleted by sending squadrons to France, he would not be able to protect Britain from invasion. A meeting of the War Cabinet followed the Chiefs of Staff meeting and they agreed that no further fighter squadrons would be dispatched to France. On the 16th of May however, the War Cabinet, heeding the requests for reinforcements, decided to send eight half-squadrons to



France. These four equivalent squadrons were to be joined by three more squadrons based in Britain who would fly to France each morning, operate from French bases and return home in the afternoon, to be replaced by three more squadrons flying over for the afternoon.<sup>6</sup>

On the eighteenth of May, Air Chief Marshall Sir Cyril Newell, Chief of the Air Staff, left with only 37 Squadrons to protect Britain, six of which had just begun to operate daily from French airfields, concluded:

"I do not believe that to throw in a few more squadrons whose loss might vitally weaken the fighter line at home would make the difference between victory and defeat in France. .It can, however, be said with absolute certainty that while the collapse of France would not necessarily mean the ultimate victory of Germany, the collapse of Great Britain would inevitably do so."<sup>7</sup>

Newell's argument convinced Churchill to direct, on 19 May, that:

"No more fighters will leave the country whatever the need in France."<sup>7</sup>

The first ten days of this campaign had cost the French Armee de l' Air 500 of its 650 fighters and of the 250 Hurricanes the British Air Force sent only 66 survived. Antoine de St Exupery, a French Air Force Officer, wrote:

"Crew after crew was being offered up as a sacrifice. It was as if you dashed glassfuls of water into a forest fire in the hope of putting it out."<sup>8</sup>

With the German Blitzkrieg shattering their defenses, the allies began withdrawing towards Dunkirk. During this withdrawal the Fighter Command was given a new mission, cover the withdrawing forces from bases in Britain. The heavy air battles

Conducted over the next few days continued the attrition of not only the Luftwaffe but also the British Fighter Command. From its start on 26 May until the end on 4 June, Operation Dynamo, the evacuation at Dunkirk, was provided air support by the 11th Group of the Fighter Command. Each day of Operation Dynamo saw 11th Group flying some 300 sorties, many of which involved major combat actions. These nine days of air battles cost the Fighter Command ninety-eight more of the Hurricanes and Spitfires so urgently needed for the protection of Britain.

The campaigns in the Lowcountries and France had been very costly for the air forces of both the Germans and the Allies. The Luftwaffe lost approximately 1300 aircraft while the Royal Air Force lost over 950. The 950 aircraft accounted for roughly half of the RAF's entire first-line aircraft. The 950 lost aircraft included 386 Hurricanes and 67 Spitfires; the two types of aircraft so desperately needed for the defense of Britain.<sup>3</sup>

### **The Battle of Britain**

After the French surrender on 22 June 1940, Hitler turned his thoughts toward the defeat of Britain, his only remaining threat in Western Europe. On 2 July 1940 Feldmarschall Wilhelm Keitel, Chief of the Obercommando der Wehrmacht noted:

"The Fuehrer has decided that a landing in England is possible, providing that air superiority can be attained....All Preparations to be begun immediately."<sup>10</sup>

The German Luftwaffe was preparing for the upcoming campaign by occupying airfields in France and the Low countries, building stockpiles of supplies and establishing command and control.

Although the British officially date the start of the Battle of Britain as 10 July, light aerial skirmishing had been conducted for several days prior.

On the first official day of the Battle of Britain there were several engagements between Luftwaffe reconnaissance aircraft, their escorts and fighters from the 11th Group. One of the reconnaissance aircraft located and broadcast the position of a large convoy in the English Channel before he was shot down.

Two large raids were launched in the afternoon, one consisting of twenty-four Dornier bombers escorted by twenty Me.109s and twenty Me.110s. This raid was targeted against the reported convoy. It was met by five Squadrons scrambled by 11th Group. The second raid consisted of sixty-three Junkers Ju.88 bombers targeted against Swansea and Falmouth. It was unopposed since the 92 Squadron which had been launched to intercept it was unable to catch the fast bombers.

The statistics for the first day were largely in the defenders favor, the destruction of thirteen Luftwaffe aircraft with the loss of only one British pilot.<sup>11</sup>

The first days pattern continued for an entire month. The Luftwaffe concentrated on the shipping in the channel. These attacks were so successful that on the twenty-sixth of July Britain suspended all daylight convoys in the Channel. During this period, 10 July - 12 August, the Luftwaffe lost 286 aircraft while the British Fighter Command lost 148. These statistics clearly reversed the experience of previous air

battles over the continent.

It was also during this period that Hitler issued his Directive No. 16 "Preparation for a Landing Operation Against England." Hitler wrote in the preface of the Directive:

"As England despite her hopeless military situation still shows no sign of willingness to come to terms, I have decided to prepare, and if necessary to carry out a landing operation against her."

"The aim of this operation is to eliminate the English motherland as a base from which war against Germany can be continued, and if necessary, to occupy the country completely...."<sup>12</sup>

With this directive in hand the German Army, Navy and Air Force began to plan for the invasion of Britain, code named Operation SeaLion. The Luftwaffe under the direction of Reichmarschall Hermann Goering began designing the air campaign plan that would allow them to destroy the Royal Air Force.

On 1 August Hitler issued Directive Number 17 which ordered the Luftwaffe:

"...to overpower the English air force with all the forces at its command, in the shortest possible time....The intensification of the air war may begin on or after 5 August. The exact time is to be decided by the air force after the completion of preparations and in the light of the weather."<sup>13</sup>

The Luftwaffe campaign plan based on Directive Number 17 was released on 2 August. The plan was code named *Adlerangriff*, or Eagle Attack, and envisioned the defeat of the RAF in a two week period. Goering was convinced that the success of *Adlerangriff* could make the invasion of England into a bloodless occupation.

*Adlerangriff* finally commenced on the afternoon of 13 August. The next twenty-four days would find the Luftwaffe

concentrating on the airfields, aircraft factories and command and control facilities of the Royal Air Force.

*Adler Tage*, Eagle Day, opened with thick fog enveloping the Luftwaffe airfields. Goering gave orders to postpone the opening operations, but these orders were not received by every unit. The initial confusion eased in the afternoon when the Luftwaffe was able to launch almost 300 aircraft with orders to smash the aircraft, airfields and command and control facilities of 10th Group in the south of England. By late afternoon every able fighter of 10th Group was airborne being directed hither and yon by the sector controllers to deal with the attacking bombers. By this time in the campaign the RAF tactics had evolved to concentrating on the bombers. The end of the confused fighting of this day saw several airfields damaged at the cost to the Luftwaffe of forty-eight aircraft lost and thirty-nine more aircraft heavily damaged. The RAF's Fighter Command lost thirteen aircraft and three pilots.

The fighting would continue throughout the month at a very heavy pace. Goering continued to target the aircraft, airfields and command and control facilities of the RAF. He believed that most of the airfields and facilities that he attacked were destroyed and would not further influence the battle. The fact of the matter was that Dowding's Forces concentrated on the repair of communications systems, radar systems and operations rooms at the expense of hangers, barracks and kitchens. The feeling was that hangers could be done without and that tents and

confiscated houses would solve the kitchen and barracks shortages. The grading of damaged runways could be performed in a short time by the newly formed mobile repair squads. While the damage to the RAF was not yet critical Air Vice Marshall Sir Keith Park, Commander of 11th Group noted:

"Contrary to popular belief and official reports, the enemy's bombing attacks by day did extensive damage to five of our forward aerodromes and also to six of our seven sector stations. There was a critical period when the damage to sector stations and our ground organizations was having a serious effect on the fighting efficiency of the squadrons, who could not be given the same good technical and administrative service as previously.... The absence of many essential telephone lines, the use of scratch equipment in emergency operations rooms, and the general dislocation of ground organizations, was seriously felt."

A development on 24 August 1940 marked a new and sinister twist in the Battle of Britain. Over 100 Luftwaffe bombers ignored airfields to attack cities in southeast England at night.

Goering, convinced that his pilots' optimistic reports of enemy aircraft and airfield damage were correct, felt that the Fighter Command had only between 150 and 300 Hurricanes and Spitfires remaining. He also felt that the damage to the airfields and command and control facilities was irreversible. Goering believed that Fighter Command was ripe for the final blow. Armed with these beliefs and in receipt of a directive from the OKW which directed harassing attacks by day and night on British cities, Goering changed his objectives for *Adlerangriff*.

The changing of objectives from the destruction of the Fighter Command to massive attacks on London were predicated on several beliefs: The first was that Germany must extract revenge

for the British attacks on German cities. Tactically Goering believed that the Fighter Command would have to rise in full strength to defend the capital and thus would be vulnerable to destruction by the concentrated forces of the Luftwaffe. Strategically it was felt that massed bombing raids on London would bring about the capitulation of Great Britain.

The twenty-four days of the Luftwaffe's concentration on the destruction of the RAF cost the Germans about 670 aircraft. However, these aircraft kills were also costly for the Fighter Command with 400 aircraft lost. Fighter Command losses far exceeded the aircraft produced by the factories under the direction of Lord Beaverbrook, the minister of Aircraft Production. Far more difficult to replace however, were the pilots who were killed, wounded or became prisoners of war. By early September 11th Group's squadrons, who had carried the brunt of the fighting, were down to an average of nineteen pilots, as opposed to the official complement of twenty-six. In the other groups the Squadrons were down to an average less than sixteen.<sup>15</sup>

Fortunately the Luftwaffe's change of tactics would prove to be the respite that Fighter Command needed. On the 7th of September Goering announced over the radio that "I have taken over personal command of the Luftwaffe in its war against England". On that day the Luftwaffe launched some 1,000 bombers and fighters to bomb London. Fighter Command unaware of the change of tactics and fooled by the formation changes made by the approaching aircraft were not in position to intercept the

bombers until after they had dropped their bombs on London. The Luftwaffe followed this massive daylight raid with heavy night raids on London.<sup>16</sup>

An ominous buildup of barges and other types of invasion craft was spotted along the Dutch, Belgian and French coasts by the United Kingdoms' Coastal Command Photographic Reconnaissance Units. This discovery prompted the RAF's Bomber Command to use all available forces to attack the ports and tributaries capable of handling these invasion craft. This bombardment continued day and night, for two weeks, with more than 1600 sorties and 1,000 tons of bombs directed against the invasion ports.<sup>17</sup> We now know that during this period of time Hitler kept delaying the decision on when to launch the invasion and ultimately decided to postpone the invasion until the spring of 1941 if it was then possible.

The rest of September was to see the Luftwaffe continue its bombing raids on London and surrounding cities. On 15 September, since known as Battle of Britain day, the largest German raids ever were launched against London and the surrounding area. These raids were broken up by twenty-four squadrons from Fighter Command and cost the Luftwaffe sixty aircraft. During the heat of this battle Prime Minister Winston Churchill, who was visiting 11th Groups operations room, asked Air Vice Marshall Park, "what other reserves do we have?" The answer "There are none".<sup>18</sup> The Battle continued as a war of attrition with the Luftwaffe losing 405 aircraft from 7 September through 30 September and the RAF losing 242 aircraft. On 27 September and again on 30 September



Goering launched large, heavily escorted bomber raids on London. The losses on these two days equalled 103 aircraft for the Luftwaffe. The losses were apparently too high. Never again did the Luftwaffe attempt to bomb London with large raids during daylight.

The Battle of Britain, not yet over, degenerated to huge nighttime bomber raids on London. These raids averaged 150 aircraft every night for the month of October and claimed the lives of 13,000 British civilians and seriously injured 20,000 more. Small numbers of the fast Junkers Ju.88s bombed strategic targets elsewhere in England during the daylight hours for the whole month. The nearing winter caused a deterioration in the weather which effectively ended the Battle of Britain on 31 October.

With the end of the campaign an accounting could be made. The RAF claimed to have destroyed 2,698 German aircraft! The Germans claimed that they had destroyed 3,058 of the British aircraft! The true loss figures were RAF 915; Luftwaffe 1,733.<sup>19</sup> To explain the almost two-to-one loss ratio in the favor of the RAF we need to investigate the differences in the two forces.

#### AIRCRAFT

When the Battle of Britain was joined the Luftwaffe held a three-to-one advantage in number of total aircraft dedicated to the campaign.<sup>20</sup> The ratio of fighters was approximately equal with the Luftwaffe having 1132 fighters arrayed against Fighter Command's 1094.<sup>21</sup> Of the RAF's 1094 fighters 96 were the

Blenheim night fighters which were slower than the Junkers JU-88 bombers and equipped with only a primitive radar aerial interception (AI) capability. During the Battle of Britain the Blenheims could only stake claim to six German bombers. Doctor E.G. Bowen, in charge of AI development, once commented, "If a Blenheim was going to catch a German bomber, that bomber had to be dawdling."<sup>22</sup>

A comparison of the main aircraft of the Battle of Britain shows the opponents to be about evenly matched. Heinz Lange, Luftwaffe Me.109 pilot, stated:

"We were confident the Me.109 was superior to the Hurricane and that it was at least a match for the Spitfire. We were better when climbing or diving, although I think both the RAF aircraft were more maneuverable. We were better armed, with 20-mm cannon, and there was no doubt about the superiority of our fuel system over the carburetors of the Rolls-Royce Merlins. We could push over into a dive without the engine faltering."<sup>23</sup>

A comparison of the Spitfire and the Messerschmitt Me.109 shows that they had the same top speed of 355 mph, the service ceiling was 34,000 and 35,000 feet respectively and that the turning radius was 750 feet for the Me.109 and 880 feet for the Spitfire.

Neither the Messerschmitt Me.110, a twin engine fighter, nor the Hurricane were a match for the Me.109 or the Spitfire. The Hurricane had a top speed almost 40 mph slower than the Me.109 at 316 mph. The top speed of the Hurricane was equal to the cruising speed of the Me.110. The Me.110 was designed as a long-range fighter escort for Luftwaffe bombers. The lack of maneuverability of the Me.110 made it easy pickings for the Spitfires. The vulnerabilities of the Me.110 were such that a

Squadron under attack would form a circle with each plane protecting the other. It became common place to see a Squadron of Me.110s circled up as protection against two or three Spitfires. By the end of the campaign Goering had directed that Me.110s would always be protected by Me.109s.

Both the Hurricane and the Spitfire were armed with eight Browning 303 machine guns mounted in the wings. Each aircraft carried 2,660 rounds of ammunition which allowed thirteen seconds of continuous firing. These guns were aimed at a point 250 yards in front of the aircraft. The Me.110 had four 7.92-mm machine guns and two 20-mm cannons mounted in the nose. It also had a single rear-facing machine gun for the second crewman. The Me.109 had two cannon mounted in the wings and two machine guns mounted in the engine cowling. The RAF experimented with mounting cannon in the Hurricanes because of the greater range and destructive power of the cannon. These experiments failed because of the lack of reliability of the cannon.

Ranges of the individual aircraft became an important issue for the Luftwaffe as the battle raged. Since the Fighter Command aircraft would not be scrambled until a raid was already forming over France and essentially fought right over their own airfields, the RAF had the time on station advantage. The Me.109 officially had an operating range of 412 miles, but in reality its range was more like 100 miles out and back with only a few minutes of fighting time available. This range limitation meant that the Me.109, even operating from airfields near Calais,

France, could engage in only a few minutes of aerial combat over London before its low fuel status forced it to turn back.<sup>24</sup>

The Luftwaffe had experimented with long-range fuel tanks for the Me.109 before the Battle of Britain. These tanks were not fitted for the Battle of Britain because of Goering's belief that the British would capitulate within four weeks. Heinz Lange, a Me.109 pilot during the campaign, in sympathy for the bomber pilots sighed:

"They always had to take the shortest and most predictable route to their targets because of our range. We operated from as close to the French coast as possible, but even so we lost a number of fighters in the Channel after they ran out of fuel."<sup>25</sup>

The long-range tanks held 300 liters and could be jettisoned when necessary. This additional fuel would have allowed the Me.109s to extend their range by 125 to 200 miles or to double their loiter time over England.<sup>26</sup>

Would the increased station time provided by jettisonable fuel tanks have made a significant difference in the campaign? The answer is no. While the battle may have raged on longer, the many advantages the RAF held would not have been overwhelmed by the Me.109. The almost two-to-one loss ratio the Luftwaffe had may have been narrowed by the additional range but it would not have been closed completely. The RAF's Spitfire would still have held the time-on-station advantage since it did not have to fly over the channel. The ability of the RAF to see the enemy massing and to be vectored to the Luftwaffe's formation coupled with the tactics of concentrating on the destruction of bombers

still would have given the RAF the advantage. The fact that the Me.109s outnumbered Spitfires 813 to 328 on 10 August gives further credence to this argument.

## STRATEGY

The Germans strategy against Great Britain changed three times during the campaign. It was initially designed to isolate Britain from being resupplied. The first month of the campaign was dedicated against shipping and the ports on the English Channel. When Hitler saw that the British would not capitulate, he directed planning for the invasion of Great Britain; these directives were the foundation Operation *Adlerangriff*. The goal of this stage of the campaign was the destruction of the RAF. The efforts were then focused on airfields, aircraft manufacturing plants and command and control facilities. This stage of the campaign was supposed to last for less than four weeks. In early September the strategy again changed, the new plan was to concentrate attacks on cities as a method of forcing the British to the negotiating table. It was during this phase that Hitler, having sustained massive damage to the German invasion fleet from the RAF's Bomber Command, decided to delay the invasion until the spring of 1941.

The British strategy was simply to defend the homeland from invasion. It supported this strategy by bombing strategic targets in Germany and by concentrating Fighter Command as a defensive force.

The Fighter Command's tactics were straightforward....

destruction of the enemy bombers while a small group engaged the bomber escorts. Usually this called for the Hurricanes to attack the enemy bombers while the faster Spitfires tangled with the bomber escorts. Air Vice Marshall Park in his NO 11 Group Instructions to Controllers NO 4, dated 19 August 1940, directed that:

"Against mass attacks coming inland, despatch a minimum number of squadrons to engage enemy fighters. Our main object is to engage enemy bombers, particularly those approaching under the lowest cloud cover."<sup>27</sup>

This direction foiled the German tactic of sending in fighter sweeps prior to massed bomber raids. The RAF ignored these sweeps since, as Air Commodore Peter Brothers stated:

"The chap you wanted was the bomber, but you often got involved with fighters. The 109s couldn't do a lot of damage other than to RAF fighters; our job was to stop the bombers."<sup>28</sup>

Goering, frustrated by the growing loss of bombers directed that the fighters maintain even closer protection of the bombers which limited the ability of the Luftwaffe fighter pilots to aggressively pursue the British fighters.

Wing Commander Patty Barthrop summed up the preceding arguments in saying:

"The airplanes were about the same. The Guys were about equal. Being over our own ground gave us a psychological edge. That and 20 miles of sea and their bad tactics is what saved us, as usual."<sup>29</sup>

The RAF's tactics were clearly superior to the Luftwaffe's; however, without the advantages that the RAF's command and control systems allowed, the RAF would have been unable to decide which raid was only a fighter sweep and could be ignored and

which was a bomber raid. They also would have been unable to amass as many fighters because some would have been caught on the ground with no advanced warning and others would have been on combat air patrol watching and waiting for the enemy to appear.

#### COMMAND AND CONTROL

Command and control ( $C^2$ ) must exist to allow the commander to see the battlefield, communicate his intent, and synchronize the battle.<sup>30</sup> It is apparent that the RAF devoid of its  $C^2$  system would have been unable to defeat the Luftwaffe. It would not have been able to identify the approaching bomber raids, direct its fighters to the decisive point or even to have alerted its fighters of the enemies approach. Without the  $C^2$  system the RAF leaders would have been unable to gain competitive advantage during the chaos of battle.

We can look at command and control as two parts -- functions and means. The functions which  $C^2$  systems must perform are: gathering information, fusing the information into a useable form, displaying the information in a way that enhances decision making, offering desirable and feasible objectives, presenting real alternatives, preparing orders and monitoring execution. These functions continue in a cycle throughout the existence of an organization.<sup>31</sup> In the Battle of Britain the functions that the  $C^2$  system performed were identifying the enemy raids building over France, tracking the impending raid, alerting the defenders, both Fighter and Anti-Aircraft Commands, and directing the fighters to engagement areas. In addition to its operational

role the C<sup>2</sup> system also had to support the normal functions of logistics and personnel management.

The means that enable a Commander to exercise C<sup>2</sup> are organizations, staffs and subordinate units; procedures, such as reports, both internal and external; and technical means, such as radio, facsimile or computers.<sup>12</sup> The technical means available during the Battle of Britain, in fact, drove both the organizational design of the C<sup>2</sup> system and the procedures used in that system.

#### TECHNOLOGY

RADAR, the eyes of the RAF, was originally called RDF, Radio Direction Finding by the British. Although the Germans, the Americans and the British all were experimenting with radar in the mid-thirties it appears that each were developing their own system independently. Early in 1935 a British scientist named Robert Watson-Watt was challenged to investigate the possibility of an electro-magnetic death ray. He quickly discounted the possibility of building a device that could transmit the fantastically large radiant power. However, he theorized that one could use radio-magnetic waves to detect airplanes rather than destroy them. To prove his theory Watson-Watt had a bomber fly back-and-forth through the center transmission beam of the Daventry's BBC transmitter while he watched a cathode-ray oscillograph. Each time the bomber entered the beam radiated energy was reflected from the aircraft, was received and displayed on the oscillograph.<sup>13</sup>



Following nine additional months of experimentation the decision was made to build a string of radar stations covering the east coast of England. The twenty stations of this system were named the Chain Home(CH). The Chain Home radars could detect aircraft at up to one hundred miles away, and could give the bearing and approximate the height and number of aircraft in a formation. Research continued even while the Chain Home System was being built. By the outbreak of war in Europe additional radar stations, called Chain Home Low, were being built. The Chain Home Low Stations were designed to detect aircraft flying at less than 3,000 feet, a shortcoming in the original Chain Home system.<sup>34</sup> Even so, not all the problems had been solved.

On 6 September 1939, only 3 days after Britain had declared war on Germany, the Chain Home station at Canewdon detected a formation of 20 unidentified aircraft heading toward London from the east. Fighter Squadrons were immediately launched to intercept the intruders. Shortly after an anti-aircraft battery spotted a formation of twin-engined bombers and opened fire. Soon the Spitfire and Hurricane fighters were engaged in battle with the enemy fighters. For nearly an hour the battle raged with the RAF losing one Blenheim twin-engine fighter and two Hurricanes. When the battle was over and the evidence was in it became clear that the Spitfires had attacked the Hurricanes and the bombers seen by and engaged by the anti-aircraft battery were in fact Blenheim fighters. It was just as clear that no German aircraft were ever seen in the area. Thus ended the Battle of

Barking Creek. This fiasco clearly highlighted a need for a system to track and identify friendly aircraft and to validate the radar detection of enemy aircraft.<sup>35</sup>

Even before Barking Creek, a system for the radar operators to identify friendly aircraft was in production. The system, named Identification, Friend or Foe (IFF), would return a coded signal to the radar station when it was triggered by a received radar pulse. This coded signal would produce a distinct shape on the radar screen.<sup>36</sup>

In order to adequately control the disposition of airborne squadrons, a way was needed to identify each squadron. To solve this problem a High Frequency/Direction Finding system was developed. This system consisted of a modification to the aircraft's radio, called "Pipsqueak", and three direction-finding receivers in each sector. Every minute the radio would transmit a 1,000 Hertz tone for fourteen seconds. This tone would be received by the three direction-finding stations and triangulated so that the location of the aircraft could be plotted.<sup>37</sup>

#### **ORGANIZATION AND PROCEDURES**

The primary organization tasked with defending Great Britain during the Battle of Britain was the Fighter Command, a subordinate command of the Air Ministry headed by Air Chief Marshall Sir Hugh Caswall Tremenheere Dowding. Fighter Command consisted of four Fighter Groups, a Radar Group, the Observer Corps and Balloon Command. Fighter Command also had operational control of the Anti-Aircraft Command of the GHQ Home Forces.

Each fighter group was responsible for a geographical area of Britain. Number 10 Group had S.W. England, Number 11 Group S.E. England, Number 12 Group Eastern Counties and the Midlands, and Number 13 Group Northern England, Scotland and North Ireland. Each group's geographic area was subdivided into Sectors with the Groups Air Squadrons assigned to the different sectors.

When a radar station saw an enemy formation coming inbound they would telephone estimates of the number of aircraft, altitude and position of the formation to a Filter Room located at Fighter Command Headquarters. In the Filter Room the reports were compared to reports received from other radar stations, the accuracy of previous reports from the reporting station and against known faults with the radar system. The Filter Room also correlated the reports coming from the Observer Corps. Only after each report was evaluated was it passed to the Operations Room collocated at Fighter Command Headquarters. The controller would then pass the information to subordinate commands:

"Information is to be told to Groups and thence broadcast simultaneously to sectors....Sectors require information accurately and speedily at a rate of one plot per minute per raid."<sup>38</sup>

Since Britain's radars were aimed seaward they could not accurately track enemy aircraft once the aircraft passed inland of the coast. To cover this area Britain relied on the Observer Corps. The Observer Corps was first organized in World War I and was staffed with volunteers who had binoculars, aircraft recognition booklets and a simple sighting device. The Observer Corps had 32,000 volunteers who manned 1,400 observation posts

during all hours and weather conditions. Once an observer had identified hostile aircraft he would report, by telephone, to the Observer Corps Center who would in turn pass the report to the Filter Room.

Each of the operations rooms had as its centerpiece a General Situation Map. This map covered the area that the operations room was responsible for, the British Isles for Fighter Command. Each Group and sector General Situation Map displayed its own area of responsibility as well as part of the adjacent group's and sector's area. Plotter's with sticks that resembled croupiers' racks surrounded the map moving color-coded markers on the map. Each plotter wore a headset and had a microphone strapped on which allowed them to talk over dedicated telephone circuits, to the operations room or filter room providing the information. Each marker was annotated with the size, altitude and direction of the plotted raid. Each of the individual markers were color coded corresponding to the time of the last update on the raid. If the color code indicated that the information on the raid was more than five minutes old the marker was removed from the general situation map.

Sitting one tier up, usually separated from the noise and confusion surrounding the general situation map by a glass wall, were the controllers. Each controller was responsible for passing raid information to selected subordinate commands by telephone or in the case of sector controllers to squadrons in flight by using the air-to-ground radio.

At the appropriate Group Operations Room the duty controller would decide on which sector should deal with the raid and how many squadrons would be scrambled. The Sector Operations Room was collocated with the direction finding station of the sector so that the Sector Operations Room had not only the radar and observer reports but also knew the location of his own fighters who were equipped with the Pipsqueak system. By watching the movement of markers on large map boards showing the location of the reported enemy formation as well as the location of his own squadrons the Sector Controller could direct the battle. The Sector Controller spoke directly with the fighter formation leaders and vectored them toward the enemy.<sup>39</sup> The Sector Controller would pass enemy information right up to the time that the fighters joined in battle with the hoped for advantage of placing the fighter into a favorable position, up sun and higher.

This organization and these procedures clearly placed the main burden of responsibility on the Groups to decide which raids were important and what forces to use in battling that raid. The sectors directed the tactical battle by controlling the fighters up until the point when the pilot had the enemy in sight. This delegation of responsibility to the groups was not always well received at Fighter Command. Air-Vice Marshall Evill, the Senior Air-Staff Officer at Fighter Command wrote:

"We do not know whether their squadrons are sent up singly or in twos or threes, or to what heights they are sent. We have no indications as to how the squadrons in the air are disposed or whether factory areas are specifically covered. There is, in fact, no general statement of the action taken....We do not know a great deal about the way they conduct operations, and there is

certainly no recognized routine for reports from groups as to what they are doing...."11

Dowding saw his and Fighter Commands function as fulfilling the strategic role. Even though he spent much of his time in the operations room overlooking the general situation map and could have at any time overridden a groups decision he chose to concentrate on providing the resources required for his subordinate commanders to fight and win.

This reporting system allowed the RAF's fighters to join the battle at the time and the place of their choosing. They had the advantage of knowing when the enemy was coming and where he was likely going. This allowed the RAF's fighters to wait on their home airfield, fueled and armed, while the enemy was spending precious time and consequently fuel forming up and flying over the channel.

#### CONCLUSIONS

On 20 August 1940 Prime Minister Winston Churchill gave a speech to the House of Commons which described the feelings of the British. During the speech he said:

"The gratitude of every home in our Island, in our Empire, and indeed throughout the world, except in the abodes of the guilty, goes out to the British airmen who, undaunted by odds, unwearied in their constant challenge and mortal danger, are turning the tide of world war by their prowess and by their devotion. Never in the field of human conflict was so much owed by so many to so few."11

While Churchill cited the importance that the pilots served in the Battle of Britain those pilots could not have overcome the three-to-one odds without the command and control systems support. A fighter who does not know the enemy is coming, who

cannot find the enemy or who must land because he spent his precious fuel searching for the enemy is of no threat to that enemy.

By removing the element of surprise from the Luftwaffe's attacks the Command and Control system enabled Fighter Command to overcome the overwhelming odds. Aircraft, tactics and pilots were all essentially equal -- the discriminator was the Command and Control system.

#### ENDNOTES

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3. Richard Hough and Denis Richards, The Battle of Britain, pp. 81-82.
4. Bickers, pp. 19-20.
5. Hough and Richards, p. 85.
6. Ibid., pp. 84-90.
7. Ibid., p. 90.
8. Herbert Malloy Mason, The Rise of the Luftwaffe, p. 340.
9. Hough and Richards, p. 100.
10. Ibid., p. 108.
11. Ibid., p. 127.
12. Francis K. Mason, Battle Over Britain, p. 121.
13. Fuehrer Directive # 17, in Hitler's War Directives, ed. by H. R. Trevor-Roper, pp. 37-38.
14. Hough and Richards, p. 236.
15. Ibid., pp. 242-251.
16. Ibid., pp. 252-260.
17. Ibid., pp. 292-294.
18. Alfred Price. "The Eyes of England." Air & Space, October/November 1990, p. 93.
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21. Bickers, p. 85.
22. Hough and Richards, p. 224.
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24. Charles Fox. "The Last of the Few." Air & Space. June/July 1990, p. 57.
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26. Len Deighton. Fighter, The True Story of the Battle of Britain. pp. 236-237.
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28. Ibid. p. 103.
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30. Lieutenant General Leonard P. Wishart III, "Leader Development and Command And Control," Military Review, July 1990, p. 15.
31. Martin Van Creveld, Command in War, pp. 5-6.
32. Ibid., p. 10.
33. Hough and Richards, pp. 49-50.
34. Ibid. p. 50.
35. Price, pp. 82-83.
36. Ibid., pp. 88-89.
37. Bickers, pp. 36-37.
38. Ibid., p. 33.
39. Deighton, pp. 93-99.
40. Hough and Richards, p. 333.
41. Fox, p. 52.

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